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NATIONAL DAM SAFETY PROGRAM. LAKE KAL-TATRI DAM (MO 31039). MIS--ETC(U)
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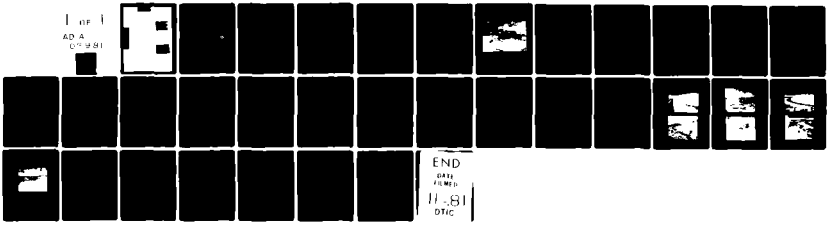

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Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

RIVER AUX VASES BASIN

LAKE KAL-TATRI
STE. GENEVIEVE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31039

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

SEPTEMBER 1978

PHASE I REPORT

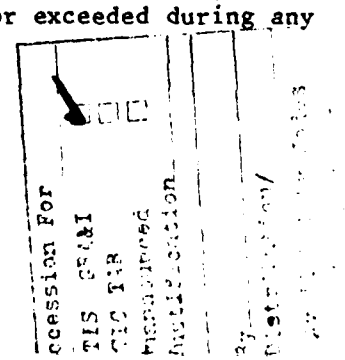
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Kal-Tatri
State Located	Missouri
County Located	Ste. Genevieve
Stream	River aux Vases
Date of Inspection	1 September 1978

Lake Kal-Tatri Dam No. Mo. 31039 was inspected using the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U. S. Army, Washington, D. C., with the help of Federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Four houses would be subjected to flooding with possible damage and/or destruction and possible loss of life. Kal-Tatri Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

Our inspection and evaluation indicate that the spillway of Kal-Tatri does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Kal-Tatri Dam is a small size dam with a high hazard potential required by the guidelines to pass from one-half PMF to the PMF. However, considering the high hazard potential to loss of life (four families) and property downstream of the dam and the fact that the two upstream dams, Butterfly and Rainbow, will pass only 20 percent and 15 percent of the PMF, respectively, the spillway size and/or height of the dam should be able to pass the PMF. It was determined that the spillway will pass 5 percent of the PMF without overtopping the dam. Since the spillway for Kal-Tetri Dam is not capable of passing a minimum of one-half (50 percent) of the PMF without overtopping the dam and causing failure, the spillway is considered seriously inadequate and the dam is accordingly classified as an unsafe, non-emergency structure. Also, our evaluation indicates that the spillway will not pass the 100-year flood; that is, a flood having a 1 percent chance of being equalled or exceeded during any given year.



A

Other deficiencies visually observed by the inspection team were the need for removal of brush on the dam slopes, and the need for riprap protection at the dam/spillway interface to prevent erosion from high spillway flows. The lack of stability and seepage analyses on record is a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described.

Thomas F. Wolff

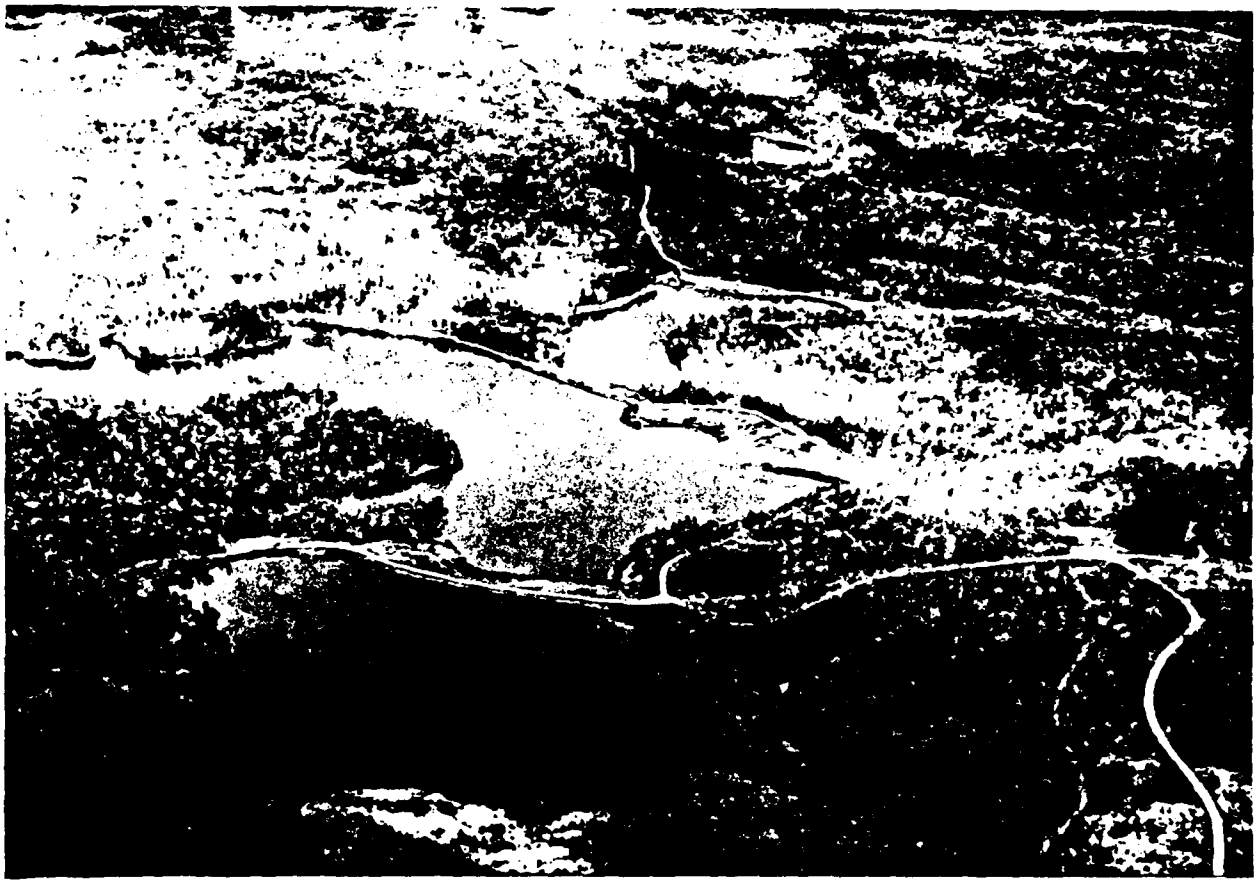
THOMAS F. WOLFF
Soils Engineer
St. Louis District
Corps of Engineers

Chien H. Hsieh

CHIEN H. HSIEH
Hydraulic Engineer
St. Louis District
Corps of Engineers

SUBMITTED BY: _____ 21 Sept 78
Chief, Engineering Division — Date

APPROVED BY: _____ 21 Sept 78
Colonel, CE, District ~~Engineer~~ — Date



Overview of Butterfly Lake, Rainbow Lake and Kal-Tatri Lake

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
KAL-TATRI DAM - ID NO. 31039

TABLE OF CONTENTS

LIST OF PLATES

LIST OF PHOTOGRAPHS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE KAL-TATRI DAM - ID NO. 31039

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Lake Kal-Tatri Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. Lake Kal-Tatri is an earth dam which provides a recreation lake for the owner and others living around the lake. Kal-Tatri is the downstream-most lake of a series of three lakes (Butterfly Lake and Rainbow Lake). Butterfly and Rainbow Lakes are owned by the River Bluffs Girl Scout Council, Glen Carbon, Illinois, and were not part of this inspection. They were inspected and reported separately from Lake Kal-Tatri because of different owners. Lake Kal-Tatri has a spillway consisting of a concrete weir with a vertical approach wall. The notched weir is located on top of the concrete wall at the right abutment.

b. Location. Section 27, Township 36 North, Range 7 East.

c. Size Classification. Small.

d. Hazard Classification. High

e. Ownership. Mr. John Kalicak, R. R. 3, Box 190, Farmington, Missouri 63640.

f. Purpose of Dam. Recreation - Resort Area.

g. Design and Construction History. The dam was built in 1966 by Mr. Kalicak, a contractor and the owner of the lake. No preconstruction design information or detailed construction data are known to exist.

h. Normal Operating Procedure. No operating records exist. Water passes over an ungated spillway.

1.3 PERTINENT DATA

a. Combined Drainage and Lake Surface Area.

.09 square miles
2.81 square miles (In tandem upstream dams)

b. Discharge at Damsite.

(1) Estimated ungated emergency spillway capacity at maximum pool elevation.

331 *cfs*

(2) Estimated experienced maximum flood at damsite - Unknown.

c. Elevation (Feet Above M.S.L.).

(1) Top of dam (minimum elevation of earth embankment) - 745.2.

(2) Spillway crest - 742.9.

(3) Maximum Tailwater - Unknown.

(4) Streambed at Centerline of Dam - estimated - 722.

d. Reservoir. Length of maximum pool - 800 feet.

e. Storage (Acre-feet). Top of Dam Estimated - 77.

f. Reservoir Surface (Acres).

(1) Top of dam - 11 acres.

(2) Spillway crest - 10 acres.

g. Spillway. The length of the weir is 26 feet.

h. Dam.

Type - earthfill.

Length - 800 feet.

Height - 26 feet.

Top width - 15 feet.

Side Slopes - 1 V on 2.5 H.

Zoning - unknown.

Impervious Core - unknown.

Cutoff - unknown.

Grout curtain - none, per Mr. Kalicak.

i. Outlet Works. None.

i. Emergency Spillway. See Section 5.1c(3) for a description of the spillway.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design drawings or data are known to exist for the construction of Kal-Tatri Dam. There are no detailed stability analyses or seepage analyses of the dam on record.

2.2 CONSTRUCTION

The dam was constructed by Mr. Kalicak, a contractor. Mr. Kalicak stated that the fill material was placed in less than 12-inch lifts and compacted with a sheepsfoot roller. The borrow area is now covered by water. There is no detailed information available.

2.3 OPERATION

No operating records exist. Outflow passes over an uncontrolled spillway.

2.4 EVALUATION

a. Availability. The only available engineering data are the personal recollections of the owner.

b. Adequacy. The field surveys and visual inspections presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the guidelines are not on record. This is a deficiency which should be rectified.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The owner accompanied the inspection team. Kal-Tatri is the downstream-most of a series of three lakes. The upper two lakes, Butterfly and Rainbow, were previously inspected and are evaluated in a separate report.

b. Project Geology. Outcrops found on both abutments and in the outlet channel are tan sandstone. The reservoir area is mapped as the Cambrian Bonne Terre formation. Thin residual soils consisting of brown clayey sand and sandy clay blanket bedrock in the reservoir area.

c. Dam. No detrimental settlement, cracking, sinkholes, sliding or significant erosion were observed in or near the embankment. Surface observations indicate the dam is constructed of brown clayey sand and sandy clay.

A typical embankment cross section is shown on PLATE 2. The 1V on 2.5H side slopes appear adequate for a dam of this height constructed from these materials. Tall weeds and light brush were present on the downstream slope. A number of small pine trees on the downstream slope had recently been cut and were laying on the slope. No large trees were present in the embankment except for one isolated group at the toe near the left abutment where the dam is very low.

The upstream slope of the dam had been covered with light brush but had recently been cleared. Cut brush was piled along the slope. Scattered sandstone boulders were present on the upstream face. Good engineering practice would be to provide adequately sized, graded riprap for wave protection; however, the very short fetch and hilly terrain around the lake minimize the likelihood of wave damage to the embankment.

No seepage was noted in or near the dam or abutments.

d. Appurtenant Structures. A concrete spillway is located on rock at the right abutment. The spillway consists of a vertical concrete wall with a notched weir. A partial concrete approach apron is provided upstream of the weir. The concrete was in good condition.

e. Reservoir Area. Some bank caving was noted immediately upstream of the spillway. This is not considered to be of any significance. No other pertinent problems were noted.

f. Downstream Channels. The spillway channel is composed of sandstone along the right face and invert, and soil and sandstone boulders to the left. In portions of the right face, soil is present under sandstone ledge rock and the face is being undercut somewhat. The outlet channel passes under a continuation of the dam road through three corrugated metal pipes in a concrete bridge-like structure. This structure allows overtopping of the road at large spillway flows.

3.2 EVALUATION

Brush and scattered small trees on the embankment are a potential seepage hazard and a potential habitat for burrowing animals. The practice of cutting the trees and brush should be continued. The boulders on the left bank of the outlet channel provide inadequate erosion protection for the adjacent earth embankment material and the erosion resistance of the embankment at this location for sustained high flows cannot be assured.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures are nonexistent since the dam has an uncontrolled spillway.

4.2 MAINTENANCE OF DAM

An effort at maintenance is evident by the cutting of trees and brush on the slopes, absence of large trees or erosion, etc. With mowing and removal of brush on the slopes, maintenance would be considered good.

4.3 MAINTENANCE OF OPERATING FACILITIES

Not applicable.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No warning system is known to exist.

4.5 EVALUATION

Additional maintenance in the form of mowing and clearing brush from the embankments is recommended.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were available.

b. Experience Data. The drainage area and lake surface area were developed from USGS Sprott and South West Weingarten, Missouri, 7-1/2 Minute Quadrangle Maps. The spillway was surveyed during the inspection.

c. Visual Observations.

(1) No drawdown facilities are available to evacuate the pool.

(2) There are no low level outlets.

(3) The spillway is located on the right abutment of the dam. The spillway consists of a weir located in a concrete wall. On the right side of the channel is a rock face. (See photographs 3, 6 and 7.) Flow over the weir will exit down a rocky channel. The spillway is judged to be sufficiently stable to pass overflows below the minimum elevation of the earth embankment, but erosion resistance of the left side of the outlet channel against sustained flows cannot be assured.

(4) Located downstream of the dam is a small concrete bridge with three 27-inch corrugated metal pipes. The bridge had no rails and appeared to be constructed as an overflow bridge. The bridge will have no hydraulic effect on the performance of the spillway. (See photographs 2, 3, and 7.)

d. Overtopping Potential. Lake Kal-Tatri will be overtopped by any flood greater than 5 percent of the Probable Maximum Flood (PMF). The guidelines require that a dam of this hazard potential (high) and size pass one-half PMF to the PMF without overtopping the dam. The two upstream dams, Butterfly and Rainbow, will pass 20 percent and 15 percent, respectively, of the PMF without overtopping the dam. Since Kal-Tatri will pass only 5 percent of the PMF without overtopping, it is probable that Kal-Tatri will be the first of the three dams to be overtopped. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The maximum discharge for 50 percent of the PMF is 11,900 cfs. The maximum depth of flow over the minimum elevation of the earth embankment for 50 percent of the PMF is 6.0 feet. The duration of overtopping over the minimum elevation of the earth embankment for 50 percent of the PMF is 13 hours. Lake Kal-Tatri will not pass a 1 percent chance

flood without overtopping. A 1 percent chance flood is a flood with a 1 percent chance of being exceeded in any given year.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of the dam and spillway are discussed and evaluated in Sections 3 and 5.

b. Design and Construction Data. These data are discussed in Section 2. Original data on the dam are not known to exist. Seepage and stability analyses comparable to the requirements of the guidelines are not on record. This is a deficiency which should be rectified.

c. Operating Records. No operating records exist.

d. Post-Construction Changes. According to the owner, no post-construction changes have occurred.

e. Seismic Stability. Kal-Tatri Dam is in seismic zone 2, for which the recommended guidelines assign a "moderate" damage probability. The relatively low height and clayey embankment material minimize the likelihood of failure due to earthquake shock.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The dam appears to be in generally good condition. Lack of adequate erosion protection on the left side of the spillway outlet channel, light brush on the dam slopes, and insufficient spillway capacity to pass the Probable Maximum Flood without overtopping the dam are deficiencies which should be corrected.

b. Adequacy of Information. Conclusions herein are based on discussion with the owner-builder, visual inspection, and field surveys. Seepage and stability analyses are not on record as recommended in the guidelines. This is a deficiency which should be corrected.

c. Urgency. We recommend the remedial measures listed in Section 7.2 be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. No Phase II inspection is recommended. The recommended remedial actions can be accomplished without further investigation.

7.2 *REMEDIAL MEASURES*

The following remedial measures are recommended:

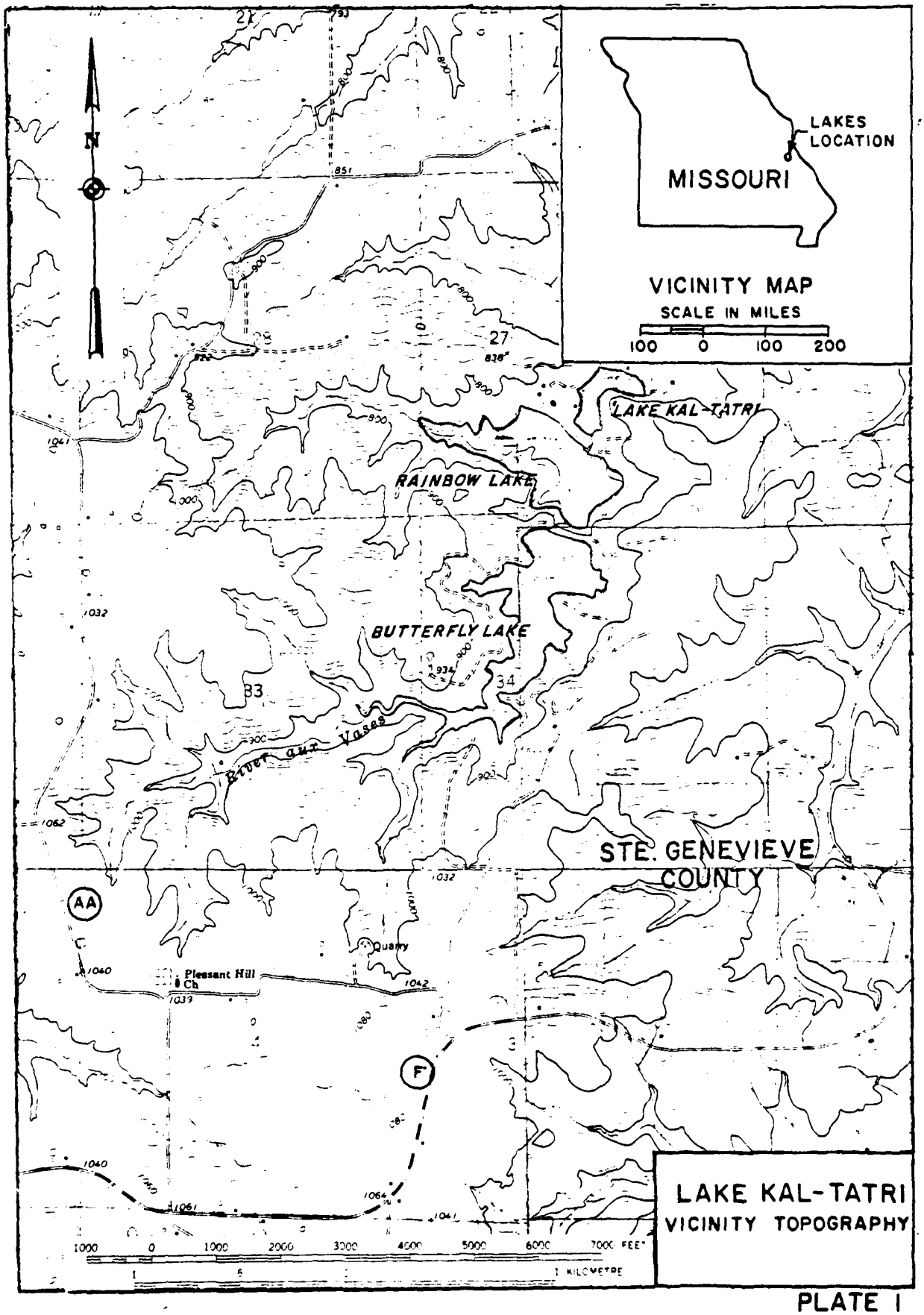
a. Spillway capacity and/or height of the dam should be increased to pass the PMF without overtopping the dam.

b. Provide better erosion protection at the dam/spillway interface left side of the outlet channel to prevent erosion due to high spillway flows.

c. Remove brush on dam slopes.

d. The dam should be periodically inspected and evaluated by an engineer experienced in the design and construction of earth dams. Records should be kept of these inspections and major maintenance.

e. Stability and seepage analyses should be performed by a professional engineer experienced in the design and construction of dams.



LAKE KAL-TATRI
VICINITY TOPOGRAPHY

PLATE 1

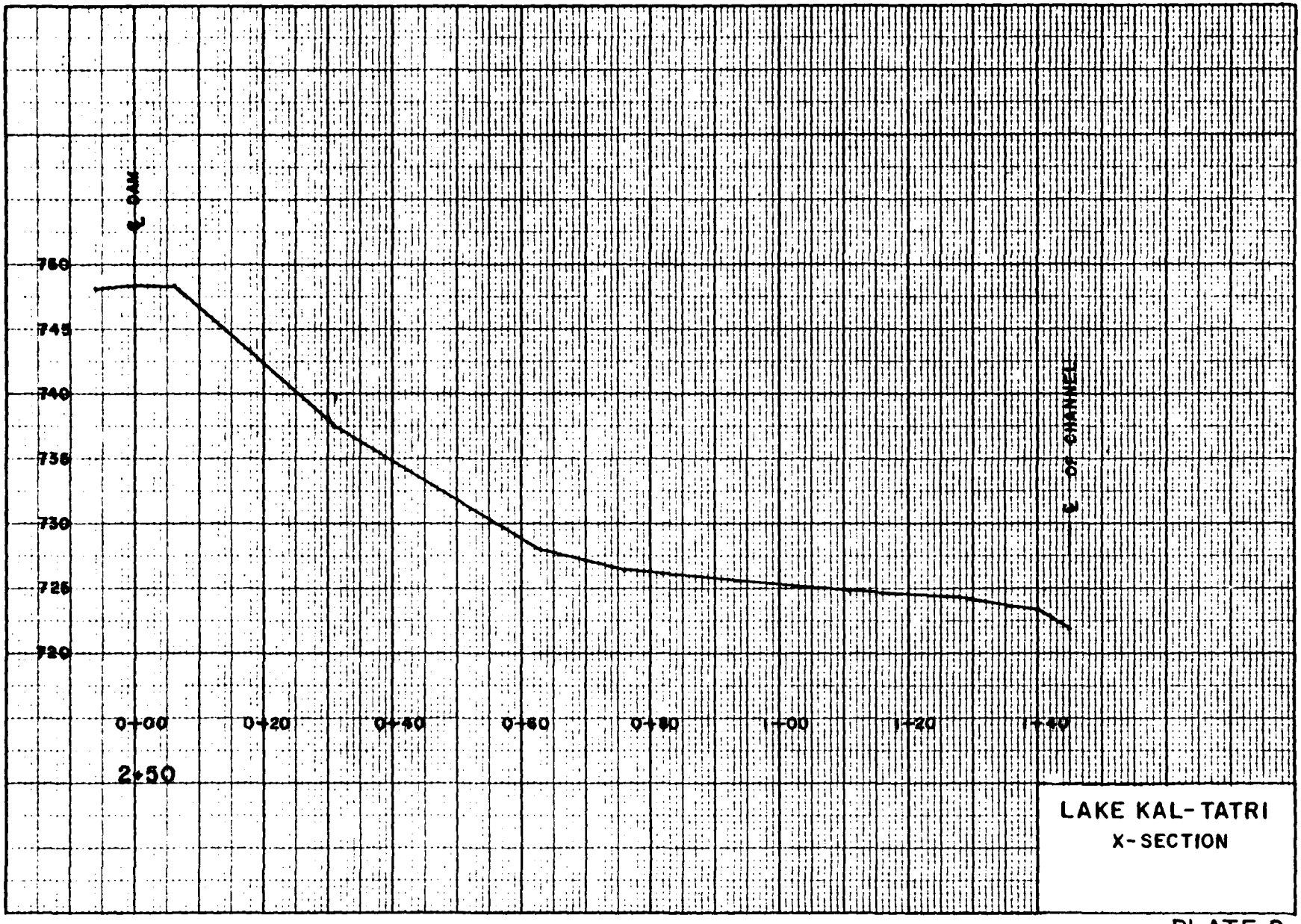

℄ DAM
750
745
740
735
730
725
720
0+00
0+20
0+40
0+60
0+80
1+00
1+20
1+40
℄ OF CHANNEL
2+50
LAKE KAL-TATRI
X-SECTION

PLATE 2

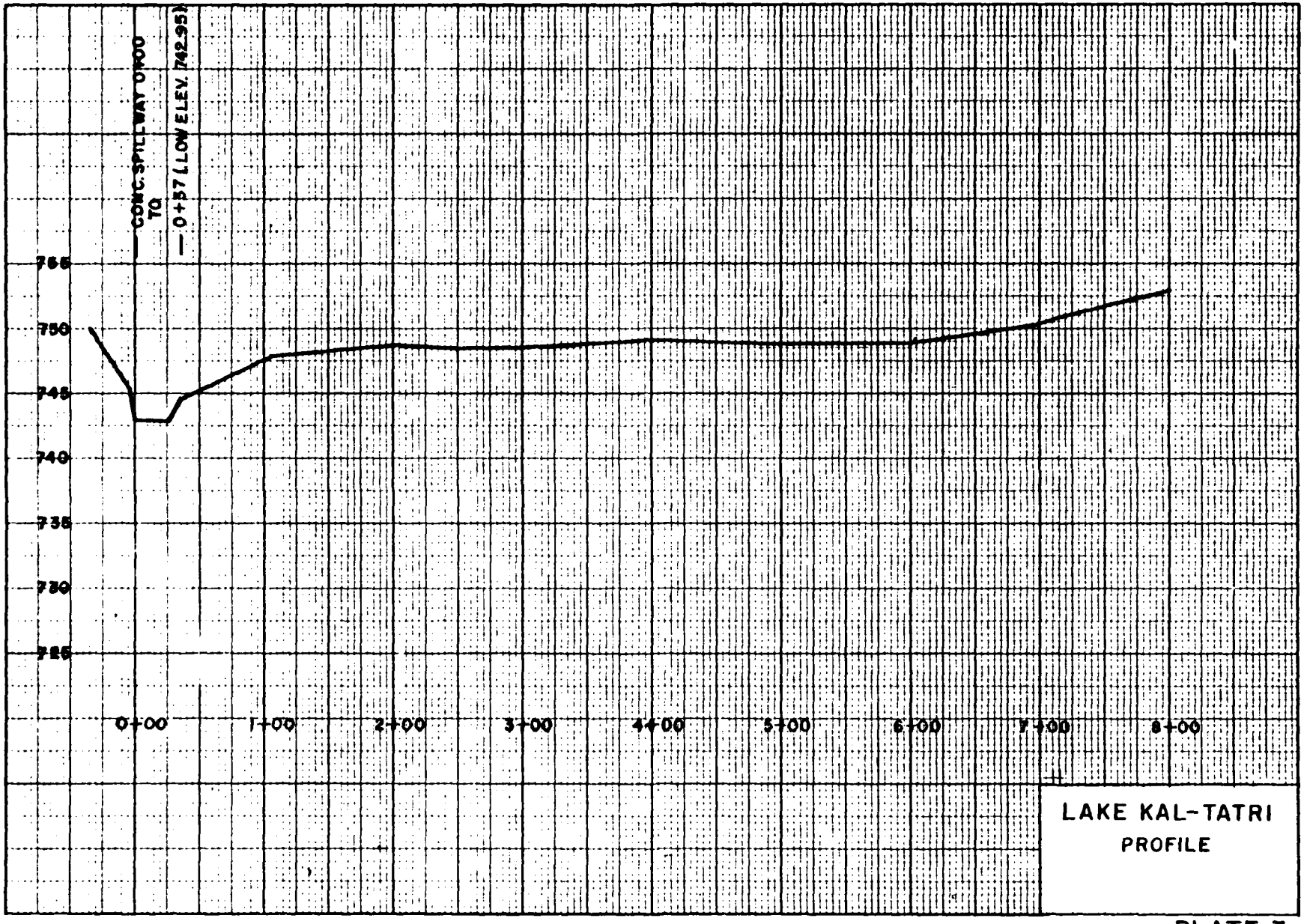
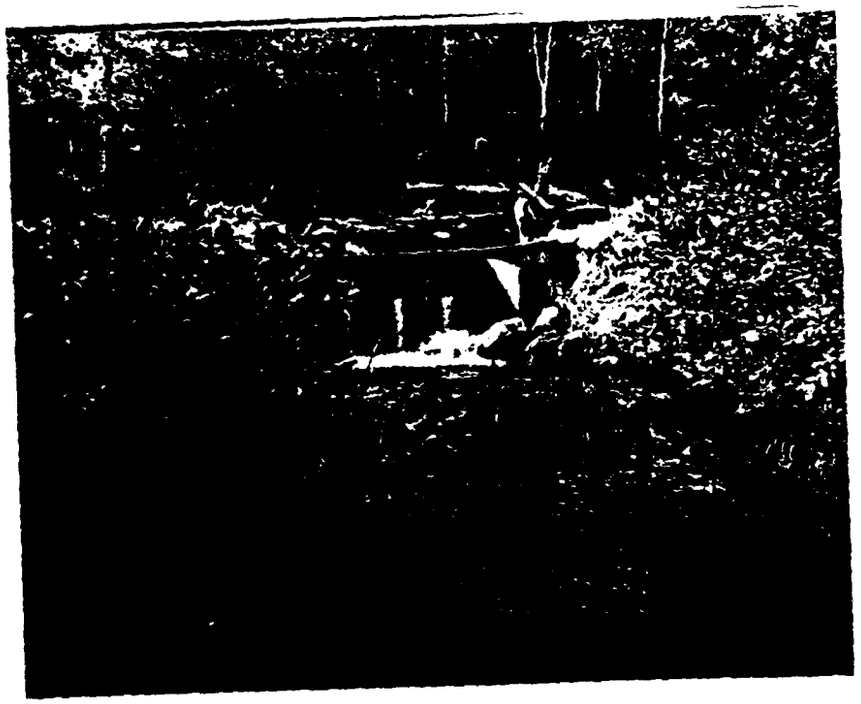

CONC. SPILLWAY 0+00 TO
0+37 (LOW ELEV. 742.95)
755
750
745
740
735
730
725
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
LAKE KAL-TATRI
PROFILE

PLATE 3

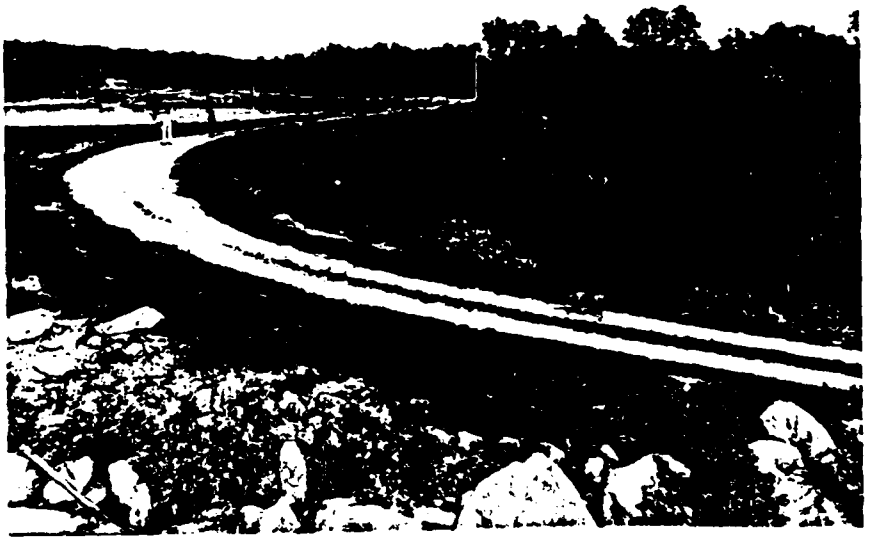
No. 1 UPSTREAM FACE

NO. 2 DOWNSTREAM BRIDGE AND CULVERTS

NO. 3 SPILLWAY AND OUTLET CHANNEL

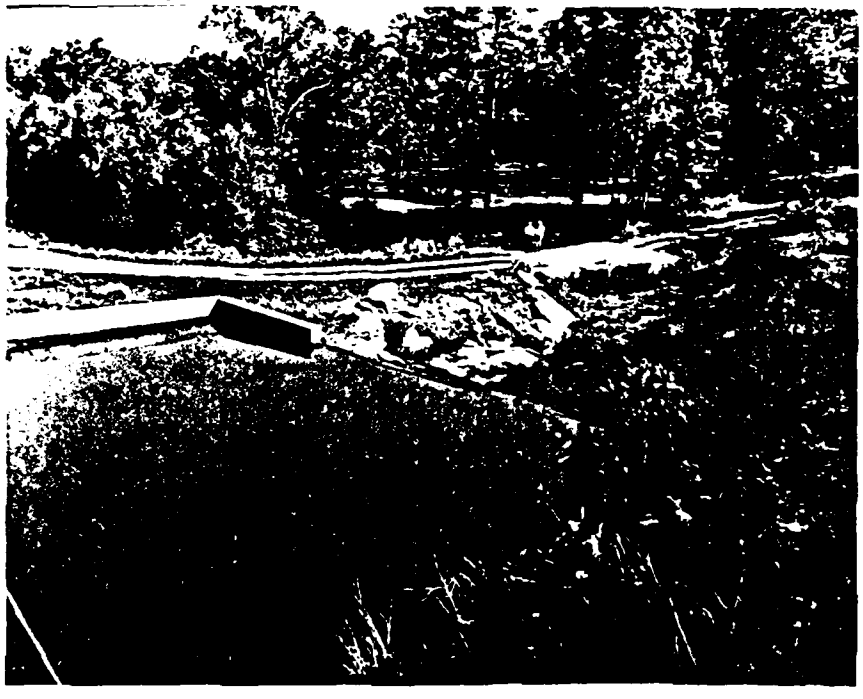


NO. 4 DOWNSTREAM BRIDGE AND CULVERTS



NO. 5 DOWNSTREAM SLOPE

NO. 6 SPILLWAY



NO. 7 SPILLWAY

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

HYDROLOGIC AND HYDRAULIC ANALYSIS [illegible]

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 24-hour storm duration is assumed with the total rainfall depth distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO 35. The non peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by [illegible] infiltration losses appropriate to the soil, land use, [illegible] moisture conditions.

2. The reservoir routing is [illegible] routing techniques [illegible] lake storage. Hydraulic [illegible] and crest of dam [illegible]. Storage in the [illegible] curve. The hydraulic capacity [illegible] top of dam are defined by [illegible].

3. Dam overtopping analysis [illegible] methods for this dam and lake. The [illegible] percentage of the PMF hydrograph [illegible] without the dam being overtopped. [illegible] hydrologic appendix [illegible] characteristics of the simulated [illegible].

4. The above methodology has been [illegible] for this report using the systemized computer program [illegible], July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The [illegible] parameters estimated for this site are listed in the attached computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  29 AUG 78
 **********
     1                A       DAM     INSPECTION
     2                A      LAKE   KAL-TATNI
     3                A      PROBABLE       MAXIMUM          FLOOD
     4                B    200       0       5       0       0       0       0       0      -5       0
     5                B1     5
     6                J      1       9       1
     7                J1   .01     .05     .10     .15     .20     .30     .40     .50     1.0
     8                K      0       1       0       0       0       0       1
     9                K1     SUBAREA  RUNOFF   FOR   BUTTERFLY  LAKE
    10                M      1       2     1.83      0       0     1.0
    11                P      0      20     100     120     130
    12                T      0       0       0       0       0       0      -1     -89       0     .06
    13                W2     0     .25
    14                X    -10     -.1     3.0
    15                K      1       2                       0       0       1       0
    16                K1     RESERVOIR   ROUTING   FOR   BUTTERFLY   LAKE
    17                Y                                    1       1
    18                Y1     1                                                -803.5     -1
    19                Y4   802     804     805     806     808     809     810     811     812     813
    20                Y5     0      75     219     411    1975    4310    8774   14895   22233   30607
    21                SA     0      67      95
    22                SE   742     802     820
    23                SS 803.5
    24                SD   808
    25                K      0       3       0       0       0       0       1
    26                K1   SUBAREA  RUNOFF   FOR     RAINBOW   LAKE
    27                M      1       2     .89       0       0     1.0
    28                P      0      20     100     120     130
    29                T      0       0       0       0       0       0      -1     -89       0     .06
    30                W2     0     .23
    31                X    -10     -.1     3.0
    32                K      2       4                       0       3       1       0
    33                K1     RAINBOW     AND     BUTTERFLY     LAKES   HYDROGRAPHS   COMBINED
    34                K      1       5       0       0       0       0       1
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    36                Y                                    1       1
    37                Y1     1                                                -767.7     -1
    38                Y4 765.6     767     768     769     770     771     772     773     774     775
    39                Y5     0      40     170     411     700    1247    2240    4028    8711   19603
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    42                SS 767.7
    43                SD 771.4
    44                K      0       8       0       0       0       0       1
    45                K1     SUBAREA   RUNOFF   FOR   LAKE    KAL-TATNI
    46                M      1       2     .09       0       0     1.0
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```
 47              P       0      26     100     120     130
 48              T                                              -1     -89       0     .18
 49              M2            .031
 50              X    -10      -.1     3.0
 51              K      2       7       0       0       0       3       1
 52              K1     RAINBOW    AND     KAL-TATRI    LAKES    HYDROGRAPHS     COMBINED
 53              K      1       8       0       0       0       0       1
 54              K1     RESERVOIR    ROUTING    OF    RAINBOW    AND    KAL-TATRI
 55              Y                      1       1
 56              Y1     1                                                742.95      -1
 57              Y4742.95    744.0   745.19     746     747     748     750     751     752     753
 58              Y5      0      88     331     545     903    1635    5989   10181   15849   22687
 59              SA      0      10      18
 60              SE    725     743     765
 61              SS742.95
 62              SD745.19
 63              K      99
```

SUB-AREA RUNOFF COMPUTATION

SUBAREA	RUNOFF	FOR	LAKE	KAL-TATRI					
	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.09	0.00	.09	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	26.00	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-89.00	0.00	.18

CURVE NO = -89.00 WETNESS = -1.00 EFFECT CN = 89.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .03

RECESSION DATA

STRTQ= -10.00 QRCSN= -.10 RTIOR= 3.00

TIME INCREMENT TOO LARGE--(NMU IS GT LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .03 VOL= 1.00

518. 145. 28. 6. 0.

FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .01	RATIO 2 .05	RATIO 3 .10	RATIO 4 .15	RATIO 5 .20	RATIO 6 .30	RATIO 7 .40	RATIO 8 .50	RATIO 9 1.00
				RATIOS APPLIED TO FLOWS								
HYDROGRAPH AT	1	1.83	1	186.	929.	1858.	2787.	3715.	5573.	7431.	9289.	18577.
		(4.74)		(5.26)(	26.30)(	52.60)(	78.91)(	105.21)(	157.81)(	210.42)(	263.02)(	526.05)
ROUTED TO	2	1.83	1	57.	159.	371.	917.	1500.	2987.	4841.	6976.	15935.
		(4.74)		(1.62)(	4.49)(	10.51)(	25.96)(	42.48)(	84.59)(	137.07)(	197.53)(	451.23)
HYDROGRAPH AT	3	.89	1	95.	474.	948.	1421.	1895.	2843.	3790.	4738.	9475.
		(2.31)		(2.68)(	13.42)(	26.83)(	40.25)(	53.66)(	80.49)(	107.32)(	134.15)(	268.31)
2 COMBINED	4	2.72	1	150.	568.	1179.	1888.	2933.	4784.	7387.	10620.	23738.
		(7.04)		(4.26)(	16.09)(	33.40)(	53.39)(	83.05)(	135.46)(	209.18)(	300.72)(	672.18)
ROUTED TO	5	2.72	1	132.	249.	567.	1140.	1979.	4354.	6990.	12762.	25284.
		(7.04)		(3.74)(	7.05)(	16.07)(	32.46)(	56.03)(	123.28)(	197.93)(	361.39)(	659.32)
HYDROGRAPH AT	6	.09	1	17.	85.	169.	254.	339.	508.	677.	847.	1694.
		(.23)		(.48)(	2.40)(	4.80)(	7.19)(	9.59)(	14.39)(	19.18)(	23.98)(	47.96)
2 COMBINED	7	2.81	1	148.	258.	587.	1178.	2021.	4422.	7091.	12920.	23599.
		(7.28)		(4.19)(	7.31)(	16.63)(	33.36)(	57.23)(	125.22)(	200.78)(	365.86)(	668.26)
ROUTED TO	8	2.81	1	137.	253.	577.	1169.	2015.	4376.	7095.	10958.	23313.
		(7.28)		(3.88)(	7.17)(	16.34)(	33.09)(	57.06)(	123.92)(	200.89)(	310.31)(	660.14)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	803.50	803.50	808.00
STORAGE	1442.	1442.	1768.
OUTFLOW	55.	55.	1975.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.01	803.57	0.00	1447.	57.	0.00	16.42	0.00
.05	804.59	0.00	1518.	159.	0.00	18.08	0.00
.10	805.79	0.00	1604.	371.	0.00	17.33	0.00
.15	806.65	0.00	1667.	917.	0.00	16.33	0.00
.20	807.39	0.00	1722.	1500.	0.00	16.25	0.00
.30	808.43	.43	1801.	2987.	.83	16.08	0.00
.40	809.12	1.12	1854.	4841.	1.50	16.00	0.00
.50	809.60	1.60	1891.	6976.	2.25	16.00	0.00
1.00	811.14	3.14	2014.	15935.	5.58	15.92	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	767.70	767.70	771.40
STORAGE	343.	343.	471.
OUTFLOW	131.	131.	1644.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.01	767.71	0.00	343.	132.	0.00	15.92	0.00
.05	768.33	0.00	364.	249.	0.00	17.55	0.00
.10	769.45	0.00	403.	567.	0.00	17.17	0.00
.15	770.79	0.00	450.	1146.	0.00	16.92	0.00
.20	771.74	.34	483.	1979.	1.42	16.42	0.00
.30	772.82	1.42	522.	4354.	3.08	16.08	0.00
.40	773.56	2.16	549.	6990.	4.33	16.08	0.00
.50	774.07	2.67	568.	12762.	5.33	15.92	0.00
1.00	775.50	4.10	621.	23284.	7.42	15.92	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	742.95	742.95	745.19
STORAGE	60.	60.	83.
OUTFLOW	0.	0.	331.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.01	744.24	0.00	73.	137.	0.00	15.75	0.00
.05	744.81	0.00	79.	253.	0.00	18.08	0.00
.10	746.09	.90	93.	577.	5.83	17.67	0.00
.15	747.36	2.17	107.	1169.	8.25	17.17	0.00
.20	748.17	2.98	116.	2015.	9.92	16.50	0.00
.30	749.26	4.07	130.	4376.	11.25	16.17	0.00
.40	750.26	5.07	142.	7095.	12.50	16.08	0.00
.50	751.14	5.95	153.	10958.	13.83	15.92	0.00
1.00	753.10	7.91	179.	23313.	16.00	15.92	0.00